ON VATACARUS IPOIDES N. GEN., N. SP. (ACARINA : TROMBIDIOIDEA) A NEW RESPIRATORY ENDOPARASITE FROM A PACIFIC SEA-SNAKE

by R. V. Southcott

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SUMMARY

A hitherto undescribed acarine is described, from New Caledonia, remarkable for being endoparasitic within the respiratory passages of a sea-snake (*Laticauda laticaudata* (L.)), with maggot-like modification of the body shape. It is named *Vatacarus ipoides* n. gen., n. sp. Only the larva is known. Within the superfamily Trombidioidea, where this mite is placed, it shows the most complete adaptation to endoparasitism that has so far been observed.

Some account of the biology of the mite is given, from the observations of its discoverer, Mr. J. Rageau.

The affinities of the mite are discussed, and a new family Vatacaridae (or subfamily Vatacarinae) is erected within the Trombidioidea, and defined. The classification of the superfamilies of the Prostigmata is discussed. The superfamily Trombidioidea Banks, 1894, is redefined. A superfamily *Anystoidea* nov. is defined tentatively, and discussed briefly.

The term "ipomorphy" is proposed for a worm-like or maggot-like adaptation of form, of animals not normally so. Within the Acarina such modification of body shape appears in general to be a response to endoparasitism, and is seen in various suborders. Endoparasitism within the Acarina is discussed.

INTRODUCTION

Recently, Mr. J. Rageau, entomologist to the Institut Français d'Océanie, Nouméa, New Caledonia, has sent the writer some specimens of a maggot-like endoparasite of the respiratory passages of a sea-snake, from New Caledonia, recognizing that they were acarine in nature. Examination of these specimens by the writer has shown that they are larval Trombidioid mites of bizarre appearance. Although endoparasitism has been described in certain instances in some of the Trombidioidea (see further below), such complete adaptation of the parasite to the host, both in the site used (the tracheal passages), and in the form affected by the parasite, has not hitherto been recorded for any Trombidioid mite. Only the larva of this form is known, and its life-history is largely unknown. It is proposed to describe it here as *Vatacarus ipoides* n. gen., n. sp., and to discuss its affinities. Comment will also be made on endoparasitism within the Acarina.

The writer is greatly indebted to Mr. Rageau for the opportunity of studying this mite, and for permission to incorporate his observations.

Descriptive Account

(a) **Vatacarus** n. gen.

Definition (larva only): A Trombidioid mite with the body capable of increasing considerably in size, to several millimetres long; shape maggot-like, with conical or mamillary projections, these more prominent posteriorly, and arising underneath the normal idiosomal setae. Coxae I and II separated. Urstigma present. Gnathosoma not greatly modified. Cheliceral fangs recurved dorsally, hinged, weakly bicuspid. Palpal tibial claw with two hooks, bent ventrially, and placed vertically to each other (i.e. sagitally). Eyes apparently absent. Dorsal scutum trapezoidal, widest anteriorly, with a single anteromedian

seta, two anterolateral setae, and a pair of filiform sensillary setae arising laterally, between the levels of the anterior and posterior non-sensillary scutal setae.

Genotype *Vatacarus ipoides* n. gen., n. sp.

(b) Vatacarus ipoides n. gen., n. sp.

Figs. 1-4*

Description of Larva (Figs. 1-4): Colour in life a bright reddish-orange, in alcohol-preserved specimens a dirty cream. Length of type specimen (ACC 335A), one of the larger specimens, 4·5 mm., width 1·5 mm. (smaller specimens were 2 mm. long or more, and other idiosomal dimensions in proportion). The animal is maggot-like in shape, the idiosoma swollen, and with the hysterosoma greatly prolonged, the latter accounting for three-quarters of the length of the animal. In addition, the idiosoma is studded with a number of mamillae or conical projections, these being more prominent dorsally and posteriorly, giving the body the appearance of a mace or studded club. The anterior part of the body is produced to a large boss, but is free from the idiosomal projections. Each idiosomal projection is developed under a normal idiosomal seta, which is short, spiniform or nearly so with adpressed ciliations, and with a slight bulge at the base of the seta. The dorsal setae are 34-62μ long, and are regularly arranged in rows across the dorsum as figured, these rows becoming less regular posteriorly (see Fig. 1 A-D). The dorsal seta arises from the summit of the projection, or a little way down its anterior face. The ventral projections are smaller, rather more mamillate, and arranged somewhat irregularly, as figured, nevertheless each carries a normal idiosomal seta. The cuticle is finely striate under the higher magnifications of the microscope; probably distension has made the striae less obvious.

The dorsal scutum is carried at the anterior pole of the animal, in a slightly recessed area. It is finely punctate all over, quadrangular (trapezoidal) with rounded corners, widest anteriorly, with projecting anterolateral angles, a sinuous anterior margin, concave lateral margins and a slightly convex posterior margin. It carries a pair of filiform sensillary setae, 87μ long, arising in sensillae placed close to the lateral borders of the shield, and with an aperture partly occluded by an eye-like transverse slit, 14μ across by 6μ high, at about the level of the middle of the shield. The scutal non-sensillary setae are stiff, somewhat constricted at their bases, then expanding and becoming elongate-lanceolate, and finally filiform; almost simple except for some adpressed ciliations as figured. With one AM, two ALs and two PLs, and thus of Trombiculid facies. There are some chitinisations in the skin near the shield (see Fig. 2B). Using the customary terminology for the Trombiculid mites the standard data of the dorsal scutum of a paratype specimen (ACC 335B) are, in micra:

AW	PW	SB	ASB	PSB	SD	A-P	AM	AL	PL	Sens	PW/SD
92	83	58	35	41	76	40	58	55	62	90	1·09

Eyes are not visible, and apparently are absent, although this point may not be finally decided until unengorged specimens are available.

The legs are of normal size among the Trombidioidea, but appear small when compared with the bulk of the larva; lengths I 370μ, II 350μ, III 370μ (including coxae and claws). All legs of 7 segments, including the coxa, and with chaetotaxy as figured. Each coxa is set in a space set between the rounded bulgings in the idiosoma; this is most marked in leg III, where the leg arises from a large boss. Each coxa carries a single seta, placed as figured, and similar to the scutal non-sensillary setae. The majority of the normal leg setae

* Figs. 1 A-E, 2 C are from ACC 335A (Type); Figs. 2 A, B, D, E, 3 A, B, 4 A, B from paratype ACC 335B; 3 C, D from paratype ACC 335C.

are simple or almost so, except terminally on the leg, where the ciliations are prominent. Tarsus I and II and metatarsus I and II each carry a single solenoidal (striate) seta. Short spiniform setae and famuli (= "microsensory setae") are present as figured. Tarsi of legs with two simple claws and an empodium; the latter tending to be retroflexed. Tarsus I 104μ long (to base

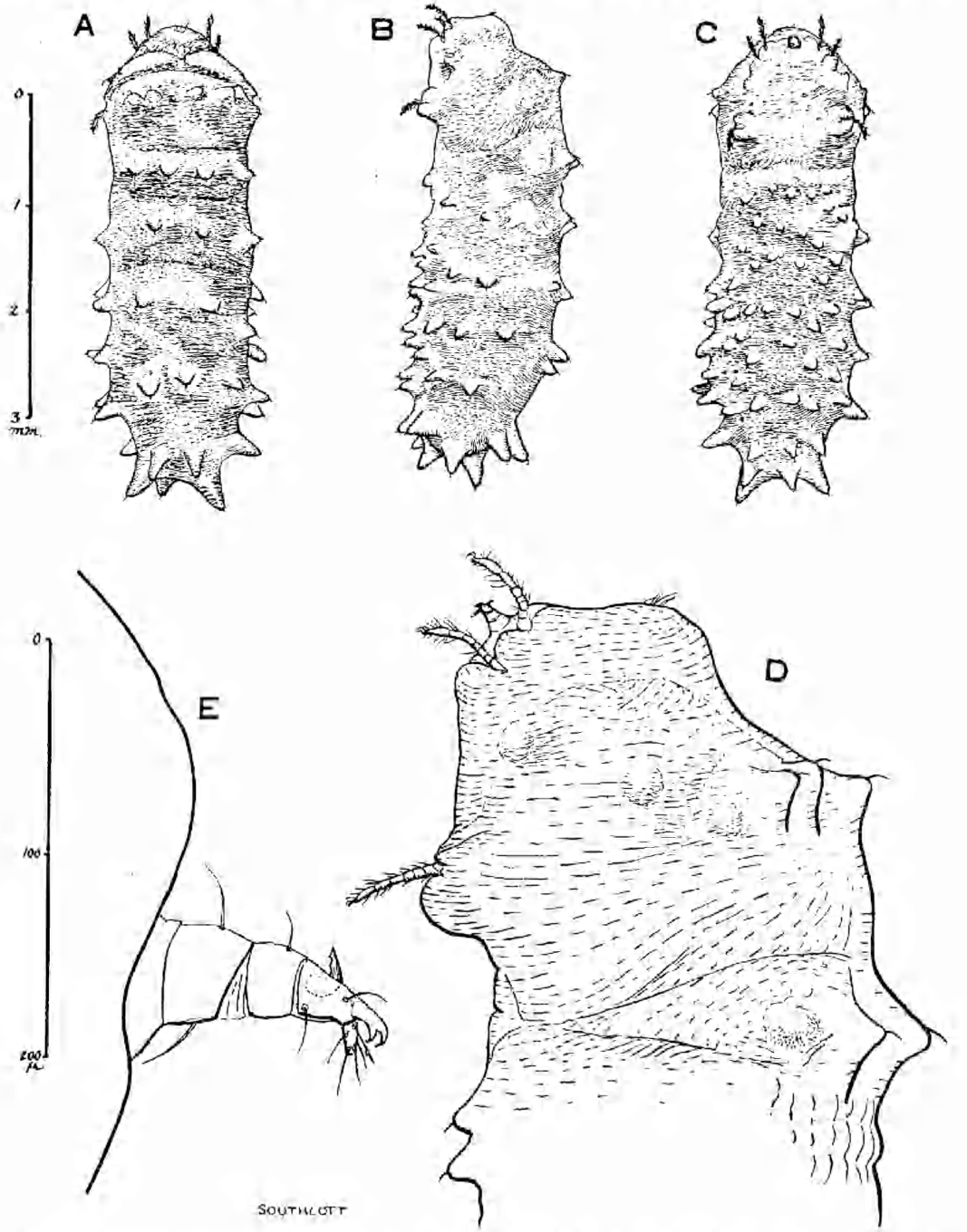

Fig. 1.—*Vatacarus ipoides* n. gen., n. sp., larva. A, B, C entire, to scale on left. A, dorsal aspect; B, lateral aspect; C, ventral aspect; D, anterior part of larva, further enlarged; E, lateral aspect of gnathosoma and adjacent part of idiosoma, to scale on left.

of claws) by 25μ high; II 83μ long, measured similarly, by 25μ high; III similarly 83μ long by 24μ high. Metatarsus (tibia) I 66μ long, II 56μ, III 58μ.

An urstigma is present in front of coxa II, and in front of this is a projecting spur (see Fig. 4). Coxa I and II are well separated. Radiating around

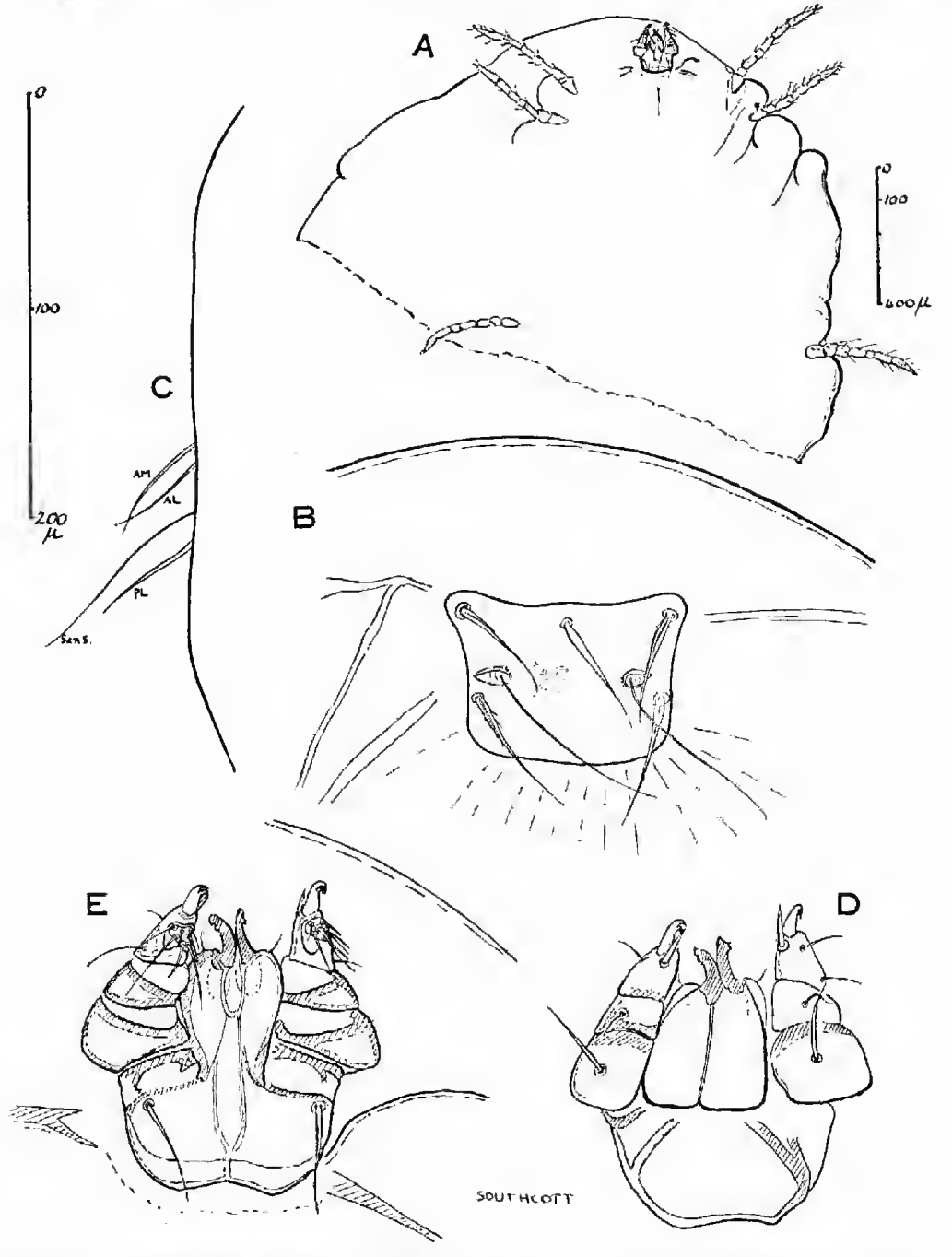

Fig. 2.—*Vatacarus ipoides* n. gen., n. sp., larva. A, anterior part of ventral surface, somewhat distorted in mounting, from compression, to scale on right; B, dorsal scutum and adjacent part of idiosoma, flattened specimen; C, lateral aspect of anterior pole of body, undistorted, with dorsal scutum hidden in its small recess, but with the scutal setae showing; D, gnathosoma from above; E, gnathosoma from below (B, C, D, E all to scale on left).

the coxae are fine lines beneath the cuticle in specimens mounted in lactic acid or in polyvinyl alcohol-lactophenol mountant, and between coxae I and II, and around the dorsal scutum; these do not appear to be muscular as elsewhere muscles are seen in these preparations which are easily recognized from the well-marked cross-striations. No evidence has been found of a true trachea and stigma (as e.g. occurs in *Acomatacarus*, family Trombiculidae).

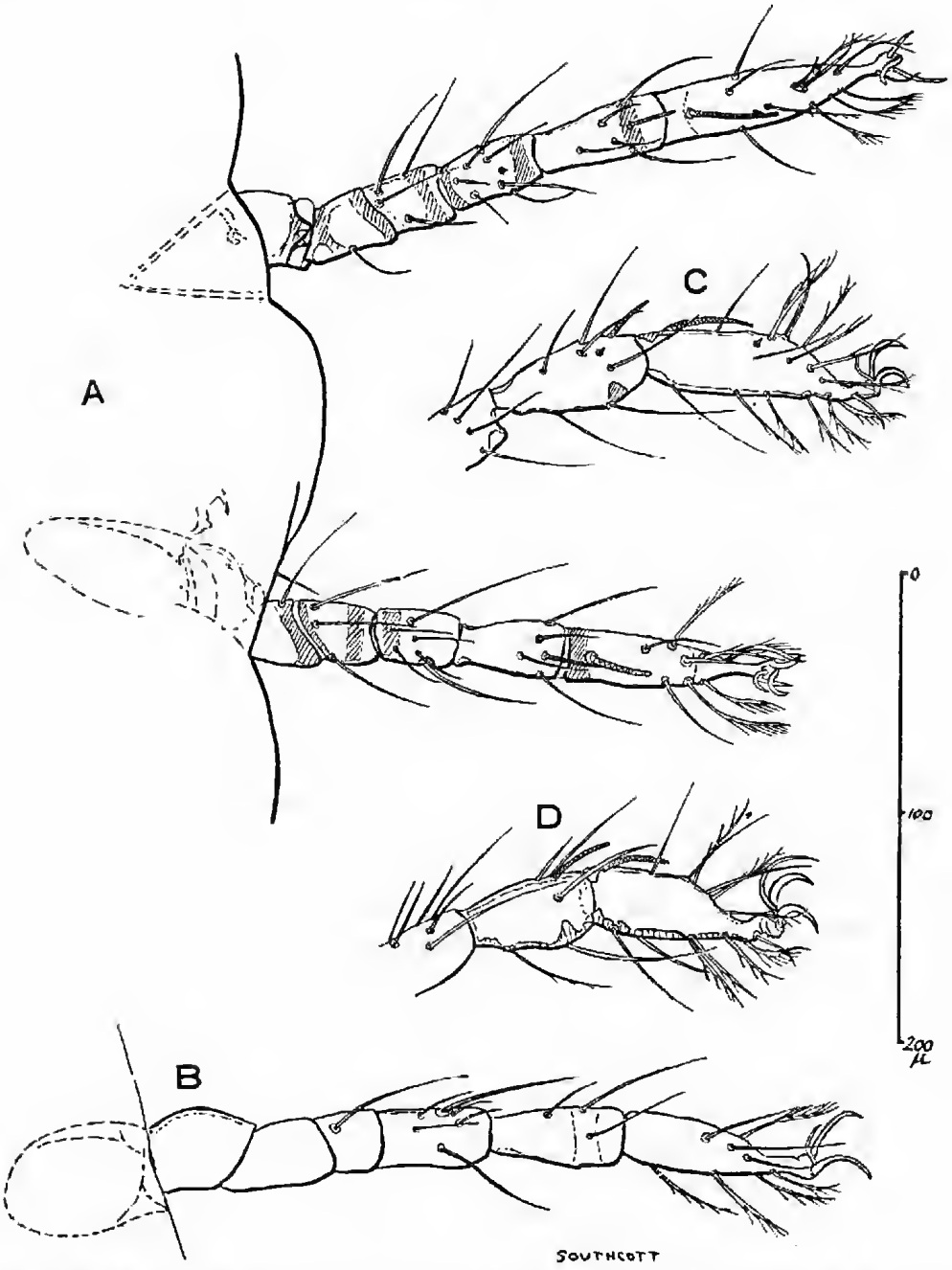

Fig. 3.—*Vutacarus ipoides* n. gen., n. sp., larva. A, dorsal aspect of legs I and II; B, dorsal aspect of leg III (same specimen); C, D, lateral aspects of legs I and II respectively of another specimen. All to scale shown.

The gnathosoma is fairly heavily chitinized, and is carried underneath the projecting anterior pole of the larva, lying level with the first pair of coxae. The palpi and chelicerae bases stout and rather compact. The cheliceral digit hinged, recurved dorsally, the blade without ventral teeth, but dorsally with a weak cusp set a little behind the terminal cusp. Galeal seta nude, 12μ long. Palpal setae nude. Seta on palpal femur and on basis capituli ("palpal coxal seta") stiff, elongate-lanceolate, similar to scutal non-sensillary setae; other palpal setae more slender, except the dorsal palpal tibial seta which is a stout simple pointed peg. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 8 setae respectively. The palpal tibial claw with two ventrally curved sharp hooks, set sagitally to each other (see Fig. 1 E).

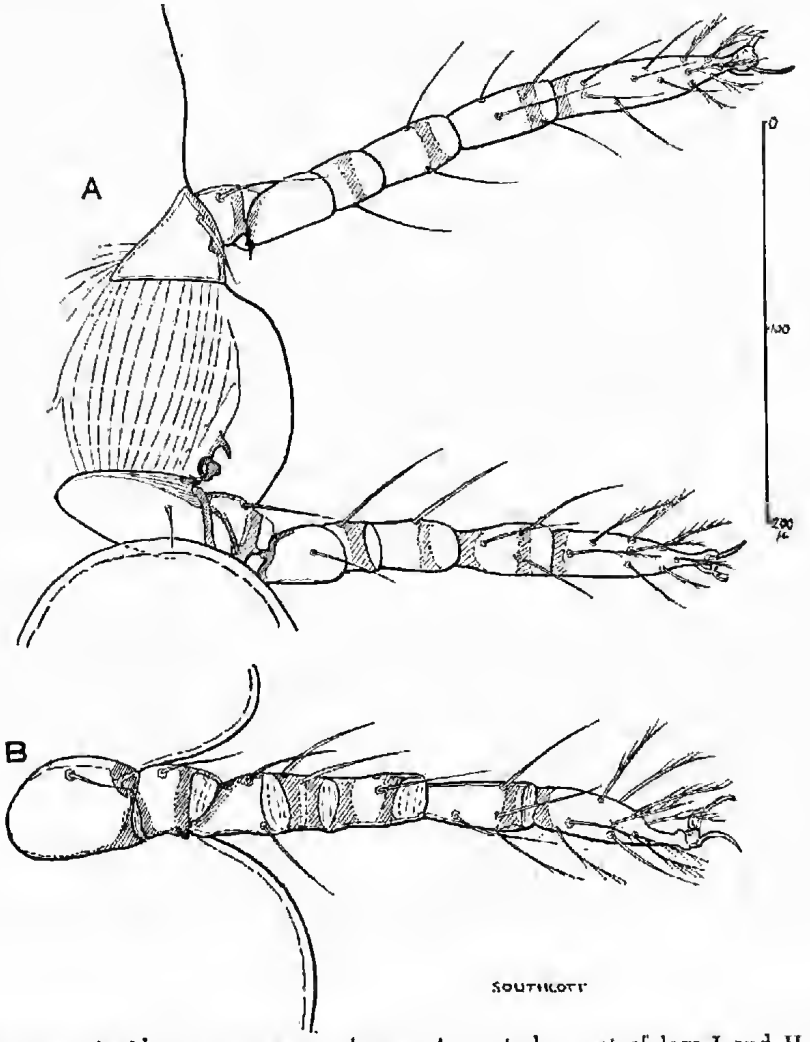

Fig. 4.—*Vatacarus ipoides* n. gen., n. sp., larva. A, ventral aspect of legs I and II, mounted specimen, same as in Fig. 3A; B, ventral aspect of leg III, same specimen. All to scale shown.

Locality: In respiratory passages ("trachea and lungs"; see below) of a sea-snake, *Laticauda* (= *Platurus*) *laticaudata* (L.), at Anse Vata, Nouméa, New Caledonia, 22nd September, 1955, collected by Mr. J. Rageau; 15 specimens forwarded, number ACC 335. All specimens in writer's collection.

The following account of various aspects of the biology of this larval mite has been received from Mr. Rageau:

Voici les réponses à vos questions sur la biologie de ces acariens:

(1) Localisation chez l'hôte: trachée-artère et poumon, remontant jusqu' aux narines et au pharynx après la mort du serpent.

(2) Mouvements: très limités. Les acariens se déplaçaient lentement par des mouvements de reptation sans utiliser leurs pattes. Leur corps était contractile.

(3) Effet pathologique sur l'hôte: apparemment aucun effet. Le serpent capturé sur la plage etait très vigoureux et ne semblait avoir de difficultés respiratoires. En disséquant l'appareil respiratoire, je n'ai pas observé des lésions. Il n'y avait pas de sang à l'intérieur du tube digestif des acariens. Aussi est-il probable qu'ils se nourrissent de mucus et de cellules épithéliales (see the comment below—R.V.S.).

(4) Biologie de l'hôte: *Laticauda laticaudata* (L.), Hydrophiidae Laticaudinae, est une espèce marine très fréquente au voisinage des côtes de la Nouvelle-Calédonie et qui vient souvent à terre, en particulier la nuit. Ainsi elle est abondante dans les îlots au voisinage de la Grande Terre et a même l'habitude de se réfugier dans les tentes des campeurs. Elle est attirée par la chaleur et lorsque l'on dort sur la plage, il arrive que l'on retrouve un de ces serpents enroulé autour de soi ou dans les vêtements au matin. Leurs écailles ventrales developpées permettent aux *Laticauda* de se déplacer facilement sur le sol et de parcourir des distances importantes. Ces serpents sont très apathiques et ont la réputation d'être inoffensifs: les pêcheurs et même les enfants les prennent à la main, sans précautions. Ils vivent uniquement de poissons. Ils pénètrent dans les estuaires mais ne semblent pas remonter dans les eaux douces. On peut donc supposer que leurs parasites sont apparentés à des formes terrestres plutôt qu'à des formes d'eau douce. Une espèce voisine, *Laticauda colubrina* Schneider, est également très commune sur les côtes caledoniennes et a une biologie similaire.

"Vous trouverez des dessins de ce serpent et des détails sur sa biologie dans: R. Bourret (1934) Les serpents marins de l'Indochine française, Institut océanographique de l'Indochine, 25e note, pp. 12-18 et planche II, Hanoi.

"Enfin, les acariens ont une coloration orange vif, tirant sur le rouge, lorsqu'ils sont vivants; cette pigmentation disparaît en alcool. J'en ai recueilli une cinquantaine d'exemplaires sur l'unique *Laticauda* disséqué mais il est probable que le serpent en avait déjà rejeté un certain nombre au cours de son agonie car j'ai trouvé les premiers exemplaires dans l'eau du bassin où venait de mourir le serpent".

From the observations of Mr. Rageau, and the extreme adaptation of form of the larva, there need be no doubt that this mite spends the greater part of its larval stage in the respiratory passages of the snake. From the structure of its mouthparts and its affinities, to be discussed below, the present writer concludes that it feeds upon tissue fluid obtained from the host, in the usual manner of the Trombidioidea. There need not necessarily be a tissue reaction to such feeding in a vertebrate, as e.g. in many cases in Trombiculid mite biting in birds and mammals, as well as in reptiles, there is no apparent reaction to ordinary observation (without histological study, i.e.).

At the present time the remainder of the life-history of this mite is conjectural. Presumably the post-larval stages of the mite are free-living, and are to be sought in the soil at situations where the snakes come ashore.

Comment on the Superfamily Trombidioidea

In attempting to place *Vatacarus* systematically it is necessary to re-examine and re-define the superfamily Trombidioidea. Such a procedure will also be useful in other directions, for systematic purposes. As far as the writer has been able to determine, the superfamily term Trombidioidea was introduced as such by Banks (1894). In his classification of the Acarina (1904, 1915) Banks used the terms Mesostigmata Canestrini 1891, Prostigmata Kramer 1877 and Cryptostigmata Canestrini 1896 as suborders, as he stated. In the Prostigmata he included the superfamilies Eupodoidea, Trombidoidea (sic) and Hydrachnoidea. The last of these constitutes an ecological rather than a morphological group. In the opinion of the present writer it is unfortunate that these relatively simple suggestions of Banks were almost completely ignored by European workers, who preferred to set up a complicated system of groupings given the names of cohorts, subcohorts and phalanges within the Prostigmata. The possibility offered by Banks' schema of providing a useful basis for superfamily classification was overlooked or ignored.

Banks (1915) included in the superfamily Trombidioidea the families Caeculidae, Trombidiidae, Anystidae (= Erythraeidae Banks 1894), Erythraeidae (= Rhyncholophidae Banks 1894), and Tetranychidae. The determining morphological criteria for the Trombidioidea (as against its nearest superfamily in the key, the Eupodoidea) was stated in the key (1915) as "Last joint [segment] of palp forms a thumb to the preceding, which ends in a claw (a few exceptions); body often with many hairs"—this referring principally to the adult forms.

In 1909 Reuter proposed the suborder Trombidiformes, the definition given (p. 246) (in a footnote only) being: "= Prostigmata + Heterostigmata Berlese (1889), vielleicht mit Einschluss der *Labidostomidae* (*Nicoletiellidae*)". The Trombidoidea (sic) was the only superfamily placed in that suborder, which was considered as consisting of the four families Trombidiidae, Tarsonemidae, Hydrachnidae and Halacaridae. The family Trombidiidae was used in a wide sense, even for that time, as it was stated elsewhere in that paper (p. 243) that it was "mit mehreren Unterfamilien, auch derjenigen der *Bdellinae*".

In 1909 Oudemans revised the classification of the Prostigmata Kramer 1877, introducing the system of cohorts, subcohorts and phalanges referred to above, all of these with suprafamilial status. The term Trombidioidea was not used. This scheme was used later by Oudemans (1923) and by Vitzthum (1931, 1940-1943), with certain modifications.

At the present time the status of the superfamilies among the Prostigmata at least needs clarification, as Baker and Wharton (1952) have pointed out in their excellent textbook of acarology. In fact, among the Trombidiformes these authors found it in general necessary to omit the superfamilies from the classification. Some clarification has been made by the introduction of the concept of the superfamily Tetranychoidea by Baker and Pritchard (1953). Grandjean (1944) introduced the superfamily term Raphignathoidea, virtually without definition. This appears to be a valid group, and the present writer has attempted to define this concept in another paper (1957a). Another useful suggestion was made by Grandjean (1947), that the "Supercohort" Apobolostigmata Oudemans 1909 be replaced by Erythraeoidea Grandjean 1947. The present writer has concurred with this suggestion elsewhere (1957b). Acting along the same lines it appears to the writer that the superfamily term Trombidioidea could usefully take the place of Oudemans' (1909) "Supercohort" Engonostigmata. The following restricted definition is therefore proposed:

Trombidioidea* Banks 1894 (restricted)

Definition: Trombidiformes (Prostigmata) in which the larva has an urstigma.† Chelicera with a hinged blade, not styliform (exsertile). Post-larval stages with genital suckers.

From the "Cohort" Eleutherengona Oudemans 1909, Vitzthum 1931 the superfamilies Tetranychoidea, Raphignathoidea and Demodicoidea have been separated. Among the remaining families are four which form a fairly precise group, these being the Anystidae, Pterygosomidae, Pseudocheylidae and Teneriffiidae. These mites are mainly predatory, but the Pterygosomidae are ectoparasitic on reptiles. For this group a superfamily Anystoidea nov. is proposed, with the following tentative definition:

Anystoidea n. superfam.

Definition: Peritreme prominent, transverse, placed anteriorly on idiosoma, and may be protruding. Chelicerae hinged (not extrusile). Coxae in one or two groups on each side. Parasitic or predatory. Larva lacking urstigma, similar to adult.

The systematics of the Trombidiformes will be considered further in later papers.

The Systematic Position of Vatacarus

On morphological grounds there is no doubt that *Vatacarus* should be placed in the Trombidioidea. A typical urstigma is present, and the chelicerae are hinged. The spur near the urstigma appears to belong to the latter, and is possibly of some morphological interest, but no importance can be given to it systematically. The mouthparts are typical of the Trombidioids, and appear to resemble those of some of the water mites.

However, among the Trombidioidea the genus *Vatacarus* is unusual in having coxa I and II separated on each side. It does not appear reasonable to ascribe this separation to the distention of the larva, although this is extreme, as in other members of the Trombidioidea, considerable distension of the larva may occur without the coxae separating, these being in fact fused together. The separation of the coxae is in fact more suggestive of the Erythraeoidea. Hitherto the only mites placed in the Trombidioidea (as defined above) for which separated coxae I and II have been recorded are *Rohaultia* Oudemans 1911 and *Monunguis* Wharton 1938. The present writer has proposed reasons elsewhere for believing that the description by Wharton (1938) of this feature in Monunguis (= *Neotrombidium* Leonardi 1901) is erroneous (Southcott 1954a, 1957c). With regard to *Rohaultia*, Vitzthum (1931) stated that that genus was the larva of *Johnstoniana* George 1909, but as the writer (1954a, 1957c) has pointed out, experimental proof of that claim has not been furnished by any writer. To the present writer *Rohaultia* is rather suggestive of some of the water mites. Its habit of parasitizing Tipulid flies is of interest, and does not conflict with the last suggestion. However, a study of the morphology of *Rohaultia* does not shed much light on the systematic position of *Vatacarus*, as these genera do not appear to be closely related.

The systematist is in fact here placed in the dilemma of accepting the apparent affinities of *Vatacarus* with the Trombiculidae on the one hand, which would logically lead to the founding of a new subfamily Vatacarinae of the Trombiculidae, or of accepting the importance of the separation of the coxae,

* Feider (1955) has proposed "Trombidoidea (sic) n. superfam.", this term being used in the sense of Trombidiidae Leach 1815 as used by most authors; apparently in ignorance of the fact that this term has been current for over 60 years.

† In one instance—that of *Microtrombidium hirsutum* Womersley 1945—the larval stage of the mite is omitted from the life history (Southcott, 1946), but it is obvious on other grounds that this mite is a member of the Microtrombidiinae.

and of founding a new family, the Vatacaridae. The discovery of the adult forms of Vatacarus will not necessarily aid in the problem, as amongst comparable mites the classification at the present time is based largely on larval characters. Both in morphological and biological features *Vatacarus* is one of the most aberrant of the Trombidioidea, and the writer favours the latter course, and proposes:

Vatacaridae n. fam.

Definition: Trombidioid mites with maggot-like ("ipomorphic") larvae. Coxae I and II widely separated. Dorsal scutum present, with one pair of sensillae. Endoparasitic in the respiratory system of sea-snakes.*

The inclusion of a biological character in the family definition is in keeping with previous practice among comparable mites. Thus Ewing (1944) included such in founding the family Trombiculidae, and separating it from the Trombidiidae. Such a procedure among the Acarina was advocated by e.g. Banks (1915, p. 17) at the generic level of classification.

Respiratory Endoparasitism of Snakes by Acarina

Various mites have exploited the respiratory passages of snakes as a biological niche. Turk (1947), in a review of these, has listed mites of the families Liponyssidae, Ixodorhynchidae, Entonyssidae and Pneumophionyssidae. All of these, however, belong to the suborder Mesostigmata.

Vatacarus ipoides is so far the only Trombidioid mite which has been found to use this niche. Some comment on the genus *Hemitrombicula* Ewing 1938 will be made below.

Endoparasitism Among the Trombidioidea

Among the Trombidioidea there are many species parasitic on vertebrates, the majority of these belonging to the Trombiculidae. Among such parasitic mites various moves toward endoparasitism may be noted. At one end of the scale we may list e.g. *Babiangia bulbifera* Southcott 1954, which appears to show the beginning of such a process of host adaptation by hiding completely under a scale of its lizard host, and by having a flattened body (we may note in passing some similarity between the dorsal scutum of *B. bulbifera* and *Vatacarus ipoides*). We may next refer to *Schöngastia* (*Schöngastia*) *oculicola* Womersley 1952, obtained from the conjunctival sac of *Leggada booduga fuvidiventris* (Blyth) (Mammalia) from Ceylon. Andy (1954, p. 139) commented on the habitat of this mite, which he placed in the genus *Doloisia* Oudemans 1910 (Andy, 1954), and referred to other Trombiculid mites which have assumed an intranasal site of parasitization. These have been recorded also by Fain and Vercammen-Grandjean (1953), Vercammen-Grandjean (1953), Audy and Vercammen-Grandjean (1955) and Fain (1955). The group is still under study, but apparently a number of species have utilized this niche.

Nevertheless, it is apparent that in *Vatacarus* the endoparasitism recorded is the most complete that has been observed among the Trombidioidea (the skin endoparasites of the family Demodicidae being placed in the Demodicoidea Banks 1894 (nom. emend. Banks pro Desmodicoidea Banks 1894, restricted).

One further mite may be mentioned here. Ewing (1938) described *Hemitrombicula simplex* as a new genus and species (monotypic) an unusual mite with two unequal tarsal claws; later (1944) he made this genus the type of a subfamily Hemitrombiculinae, placed in the Trombiculidae. This mite was recorded as parasitic within the mouth of a North American snake, *Elaphe*

* According to Reid (1956) *Laticauda* is the only genus of sea-snake which is land-going and probably therefore *Vatacarus* is unlikely to be found in other sea-snakes.

obsoleta obsoleta (Say), where the mite larvae were "attached between the rows of teeth on the upper jaw only"; this was the only record for this mite. In 1947 Wharton rejected the genus from the Trombiculidae, but did not re-assign it, as Lawrence (1949) pointed out, and such only occurred in 1952, when Baker and Wharton (*loc. cit.*) synonymised *Hemitrombicula* with *Limnochares* Latreille 1796. These latter authors made no comment on the parasitization of the snake by the larval mite, which must be very unusual for a *Limnochares*. The synonymy proposed should be confirmed by a redescription of Ewing's *H. simplex*.

Ipomorphy and Endoparasitism Within the Acarina

The term "ipomorphy" is proposed here to denote a modification of an animal to a worm-like or maggot-like shape, in groups not normally so. The writer is of the opinion that this word will fulfil a definite need, and has not been able to find any existing noun available, from consultation with a number of texts on zoology and parasitology. Reference to the great "Oxford English Dictionary" shows no appropriate noun derived from the Greek roots, *ἰψ* and *σκώληξ*, which appear to be the best to use, nor from the Latin *vermis*. The term scolex has now mostly taken on a special meaning in zoology, and the writer favours "ipomorphy" as being in line with current terminology in morphology.

Ipomorphy is seen among various of the Acarina, in groups apparently unrelated. When present, the idiosoma also shows often a degree of annulation. Thus within the endoparasitic Eriophyidae (Tetrapodili, Trombidiformes), which are plant parasites, and the Demodicidae (Demodicoidea, Trombidiformes), as well as the free-living genus *Nematalycus* Strenzke 1954 (Nematalycidae, Trombidiformes), such is the case. Within the Tetranychoidea (Trombidiformes) a similar modification has been recorded by Baker (1948) for *Tenuipalpus eriophyoides* Baker 1948. Within the Mesostigmata similar ipomorphic forms are seen, e.g. among the Halarachnidae, which are endoparasites of the respiratory passages of mammals, and the Entonyssidae, which utilize a similar biological niche in the land snakes, and the Rhinonyssidae, which use birds similarly. A recently discovered group of mites, the Gastronyssidae (Sarcoptiformes), which are endoparastes of bats, also show ipomorphy. These have been recorded from either the stomach or the nasal fossae of the hosts (Fain 1956).

Generally speaking, the presence of ipomorphy within the Acarina appears to go with the adoption of endoparasitism. There are, however, a number of mites which have made a partial or fairly complete move towards endoparasitism, in which ipomorphic forms have not as yet been observed, e.g. the genus *Riccardoella* (Ereynetidae) and the various Speleognathidae. It would appear that among the Acarina the development of ipomorphy must be considered as a polyphyletic character. Although useful therefore in an ecological classification, it cannot be used as a major systematic character.

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